Senior Thesis Process book

A Smart Lighting System Designed for the Union South Garage

DELIGHT

by Amber Fan

DELIGHT — A Smart Lighting System Designed for the Ohio Union South Garage

Research Thesis
Presented in partial fulfillment of the requirements for graduation with research distinction in Industrial Design in the undergraduate colleges of The Ohio State University

by
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As a design constraint, this project is set within Lighting Design.

Table of Contents

Where I Started.....

Student Suicide

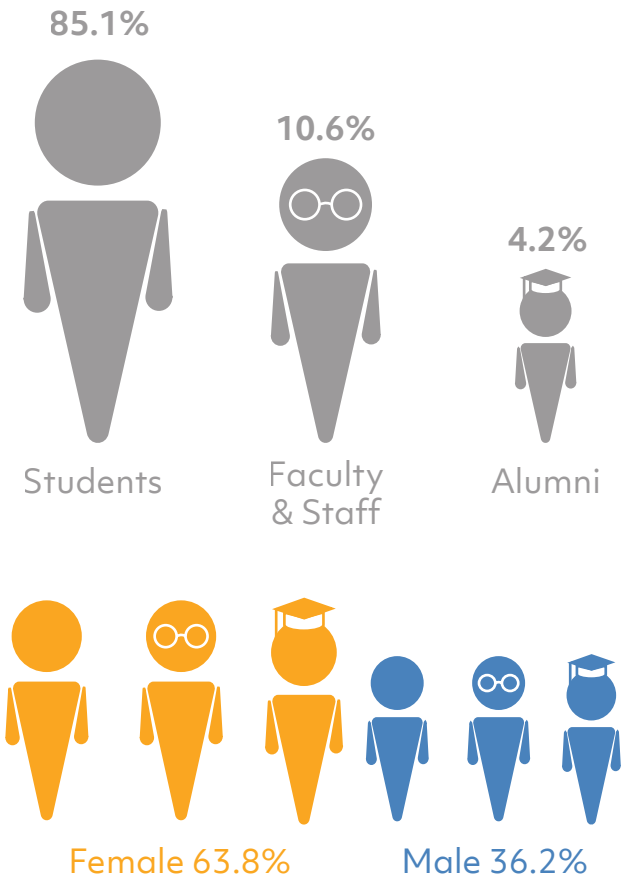
In April 2017, a student died after jumping from the Ohio Union South Garage.

In April 2018, two students “fell” from the Ohio Union South Garage within a four-day period, resulting in one death and one injury.

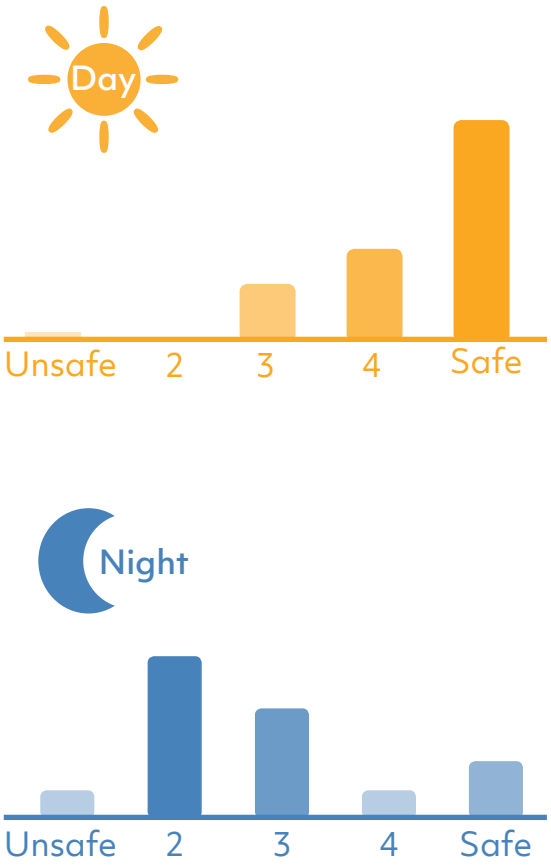
In September 2018, another student died from a “fall” in Lane Ave Parking Garage.

Primary Research: Survey on Campus Parking Garage Environment

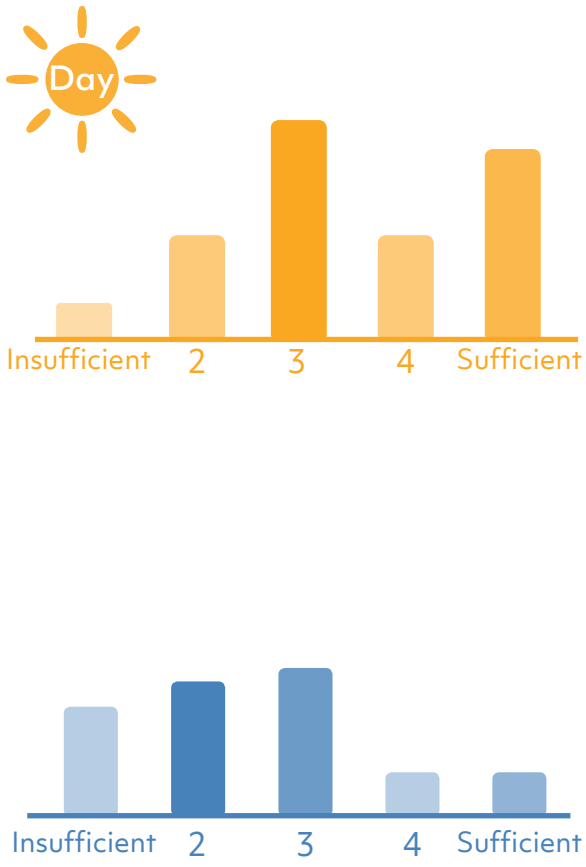
Total of **47** Participants



Sense of Safety in Garage



Lighting Condition in Garage



Survey Conclusion

Sense of Safety in Garage

More people feel unsafe when using the garage at night compared to during the day

Lighting Condition in Garage

More people say that lighting is insufficient at night compared to during the day

Primary Research: OSU Campus Daily Crime Log

Garages	Number of Crimes	Nature of Crime
Union South Garage	●●●●●	Non-Violent
Safe Auto Garage	●●●	
12th Ave Garage	●●●	Theft
Arps Garage	●●●	Drug use
Lane Ave Garage	●●	Drug dealing
9th Ave Garage	●●	Property damage
Neil Ave Garage	●	
South Cannon Garage	●	
North Cannon Garage	●	

From 7/05/19 to 9/03/19

Primary Research: Field Study in 6 Campus Parking Garage

Union South Garage

Lane Ave Garage

12th Ave Garage

9th Ave Garage

SafeAuto Garage

Neil Ave Garage

Primary Research: Field Study Findings

1.

Monolithic and brutalist interior space

2.

Limited emergency measures

3.

Fences are inconsistent & discontinuous

What else did I do?

Expert Interview with Professor Rebekah Matheny:

1. Standard vs. Contemporary Parking Garage
2. the Well Building Standards
3. 14 Patterns of Biophilia
4. the Dark Sky Regulation
5. Lighting Technology

Secondary Research on:

1. Student suicide across American universities
2. Lighting and suicide prevention
3. Lighting and safety
5. Lighting design and color psychology

Recap: Key Problems Identified in Campus Parking Garage

Monolithic and Brutalist Interior Space

1

Lack Sense of Safety When Using the Garage

2

Non-violent Crimes Occur in the Garage

3

Where I Landed.....

Since I had a basic understanding of the overall campus parking garage environment, I eventually chose to focus on the Union South Garage due to its high suicide rate as well as crime rate.

Reaccess the Union South Garage: Observation

1.

Monolithic and brutalist interior aesthetic

2.

Light casts shadow on ceiling

3.

Uneven light distribution on the ground

Problem Statement

Given that the Union South Garage has a monolithic and opposing interior space.....

and that it has a fairly high crime rate.....

there is a need to improve its environment, creating a more positive and safer space

for students' wellbeing.

Quick Flashback: Secondary Research

Lighting & Safety

According to Crime Prevention Through Environmental Design, illumination is the most significant factor affecting both user perception of safety and actual incidence of crime.

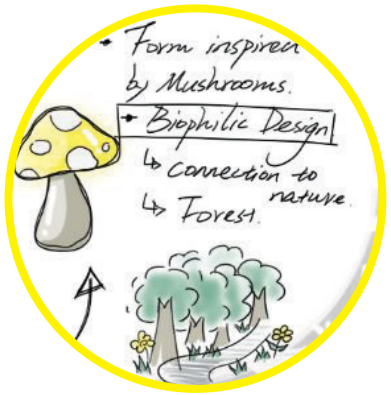
Visibility is the central component of natural surveillance, permitting the intended users to observe other users of the space.

—"Performance of Campus Parking Garage in Preventing Crime"

What Next?

Now that the first phase of my research is completed, I've gained some knowledge regarding lighting design and identified potential pitfalls of the lighting condition in Union South Garage. Next step is to move into quick ideation and concept generation.

Design Conjecture 1: Accent Lights in Union South Garage



- Form inspired by mushrooms (visual connection with nature)
- Sits on the edge of garage walls

Interior View

- Semi-directional, diffused lights
- Column-based shape imitating protective barrier

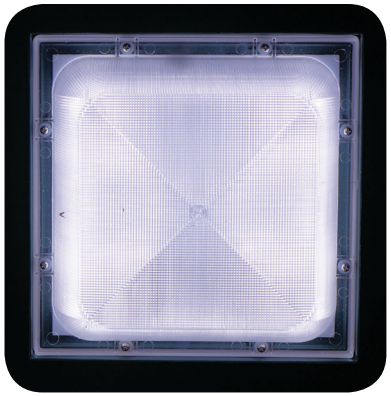
- Wall light
- Curvy form contrasts w/t existing environment

Design Conjecture 1:

- Each floor is a different color
- Rainbow effect

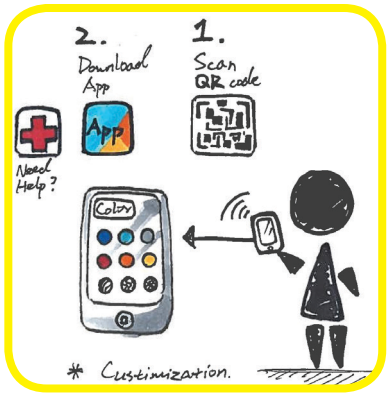
Design Conjecture 2: Wall Lights

Current Ceiling Light



- Uses Tensile Fabric (highly customizable)
- Shape based on current ceiling light in the garage
- Introduces color to the space

Design Conjecture 3: Smart Wall Panel



- Luminous Textile Panel
- Built-in sensors
- Creates subtle movements
- Integrated App allows for color customization & counseling services

Evaluative Research

Design Concept 1

Rethink the lighting system in Union South garage in hope to achieve a more uniformed lighting projection, eliminating large areas of shadow.

Design Concept 2

Use of chromatic lighting. Its built-in motion sensors detect vehicle and pedestrian movements, thus changing color accordingly. The color-change effect increases people's awareness of their surroundings.

Research Objectives

Design Concept 1

Understand the current lighting condition in the Union South Garage through collections of quantitative data.

Design Concept 2

Understand the physical and psychological effects of color-changing lights on people through collections of qualitative data.

Research Methodology

Design Concept 1

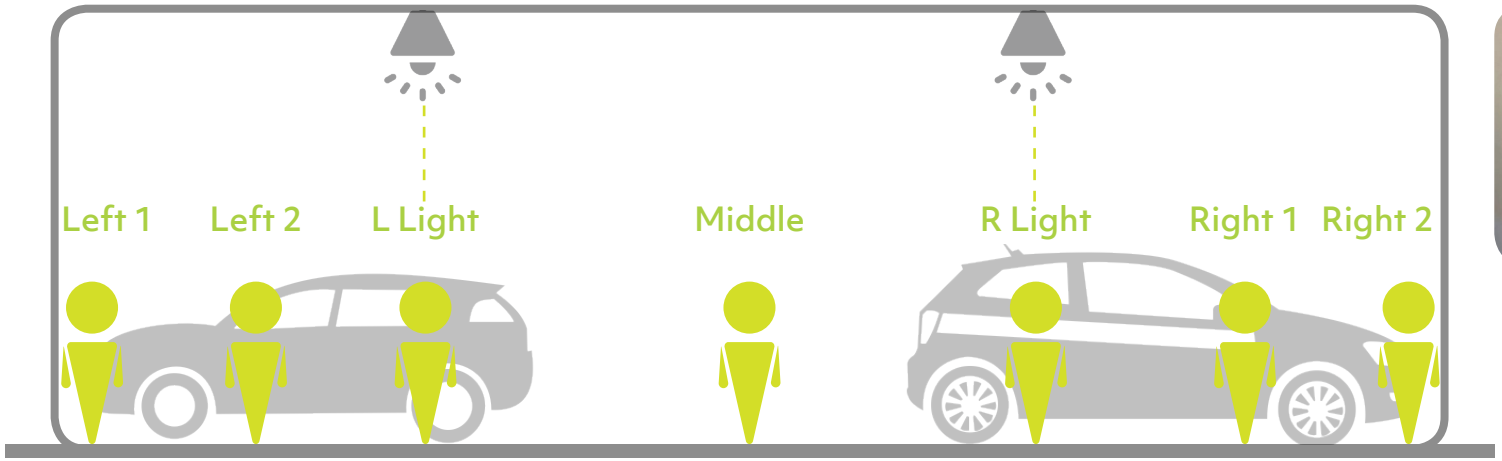
Use a light meter, measure the horizontal and vertical illuminance across garage ramp. Compare the collected data with *IESNA* Lighting Recommendation for Garages.*

*Illumination Engineering Society of North America (IESNA)

Design Concept 2

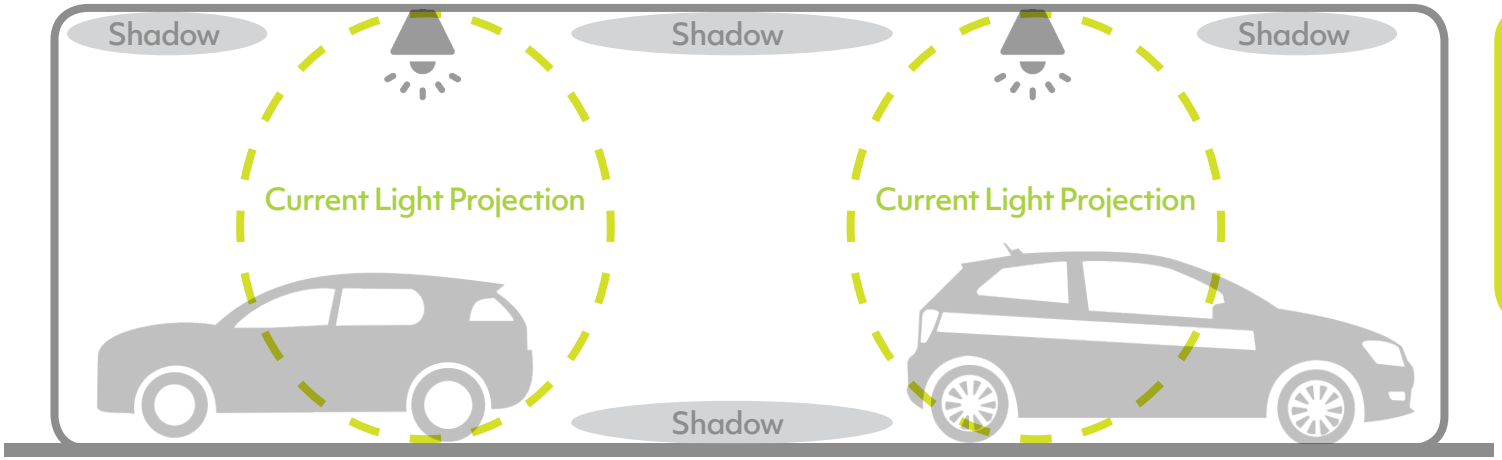
Create Keyshot animation of the lighting fixture changing color. Send out questionnaires based on the animation to gather people's opinions.

Evaluative Research: Findings for Design Concept 1



Light Meter

I stood at these places and took measurements using a light meter.



The current ceiling light projects a blob of light. This ununiformed light projection leaves out shadow areas.

Evaluative Research: Questionnaire for Design Concept 2

15 Participants
All questions are based on a 1 to 5 scale

1 How noticeable is the color-change?

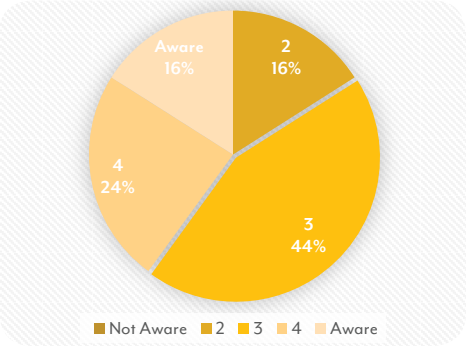
2 How useful is the color-change in regards to safety concerns?

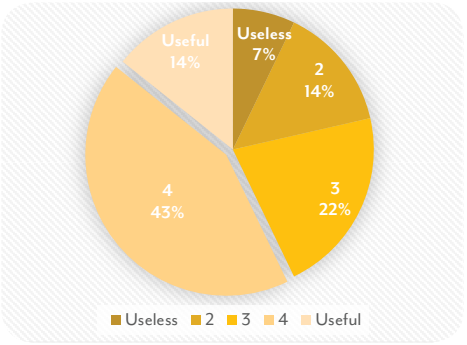
3 How comfortable is the color-change to the eye?

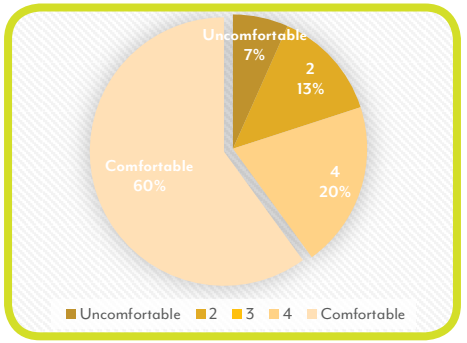
Evaluative Research: Findings for Concept 2

winners are circled out

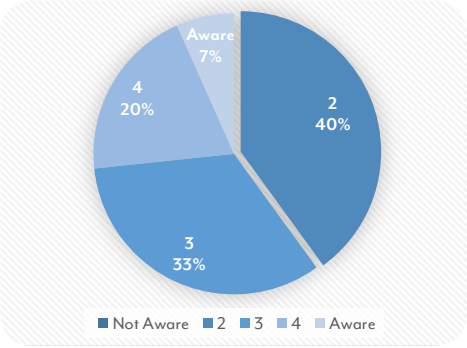
Animation 1:
light fades from white to orange

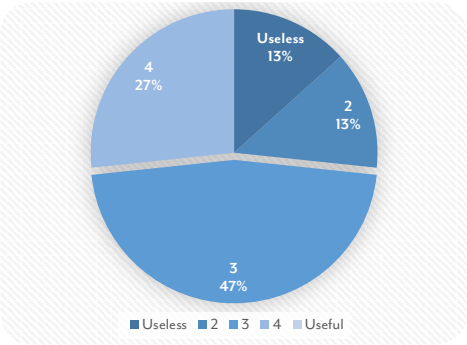


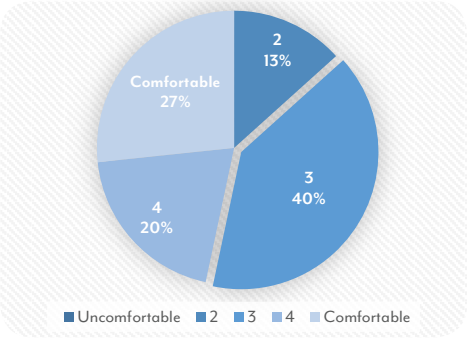




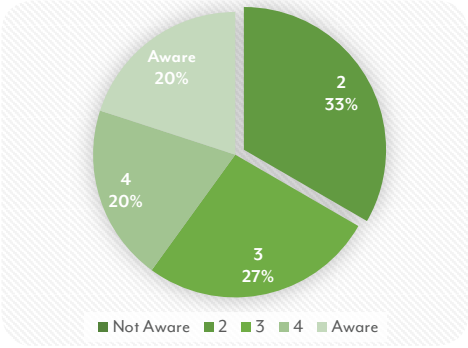
Animation 2:
light fades from white to blue

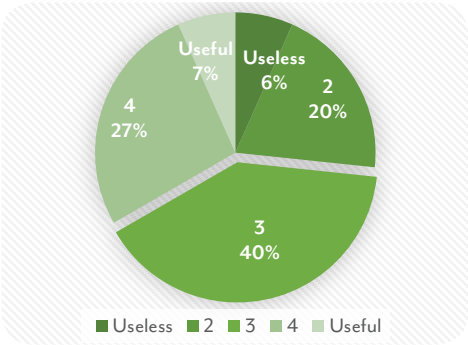


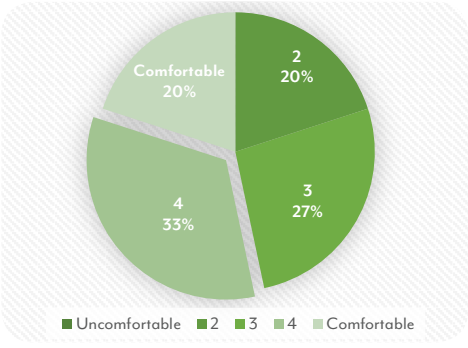




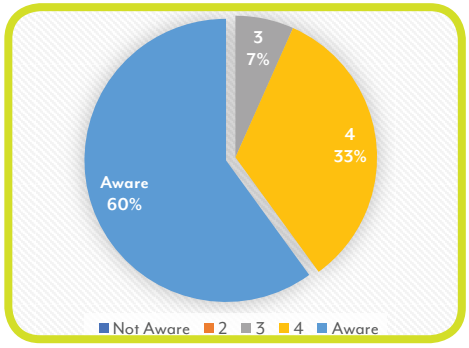
Animation 3:
light fades from white to green

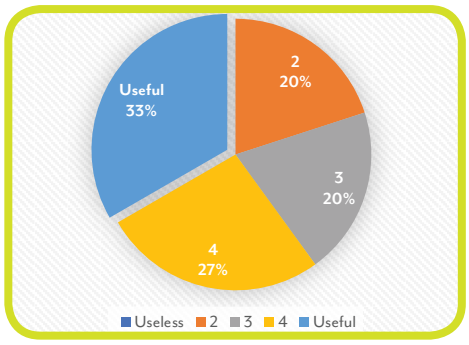


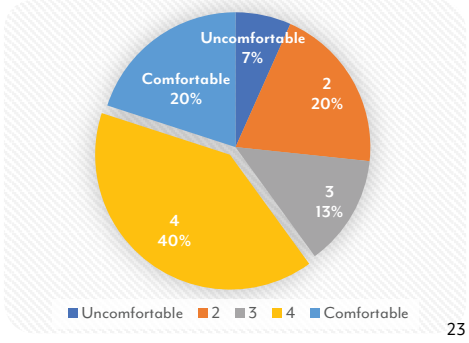




Animation 4:
all colors combined







Research Objective

Design Concept 1

Rethink the lighting system in Union South Garage. Understand the current lighting condition in the garage, identify needs for improvements.

Design Concept 2

Implement chromatic lighting. Understand its psychological effects, determining which color helps increase people's awareness of their surroundings.

Main Takeaways

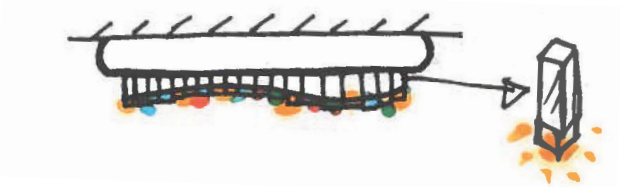
Design Concept 1

There is a need to either increase number of light fixtures or widen beam projection of each fixture to eliminate shadow areas in the garage.

Design Concept 2

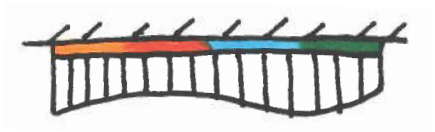
Animation four received high ratings, where the light changes from orange to green to blue and back to white. However, there are concerns that the constant color change might be overwhelming.

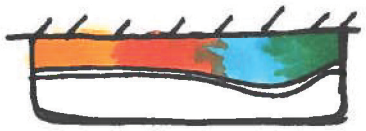
Ideation: Sketch

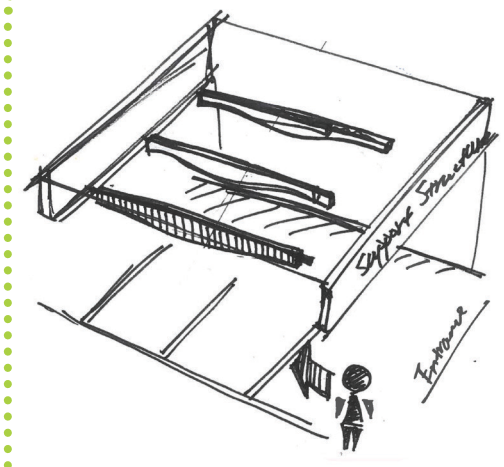


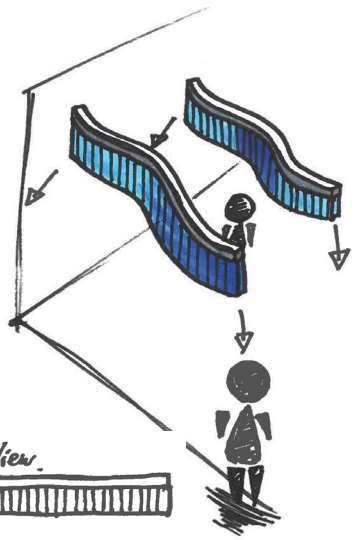
Two Part Light
(white + colored)

Color-change based
on noise level









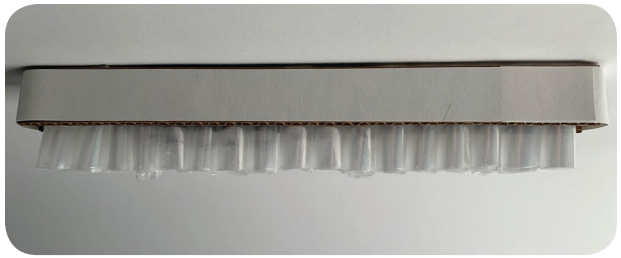
Changes color as
people walk pass

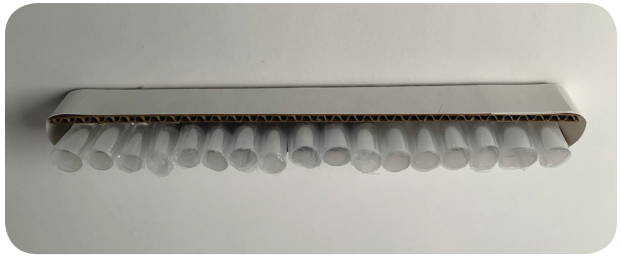
Color-change and
movement tracking

Form Development: Quick Prototyping

1

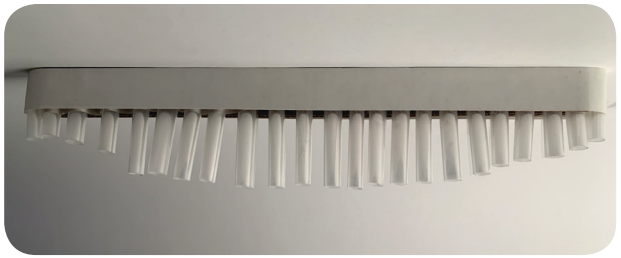
2



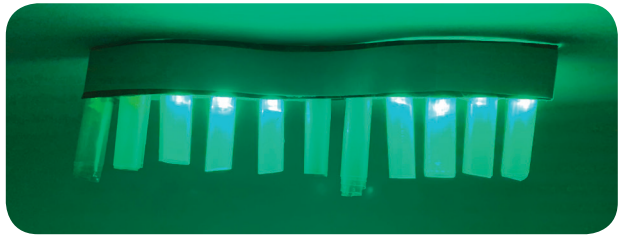


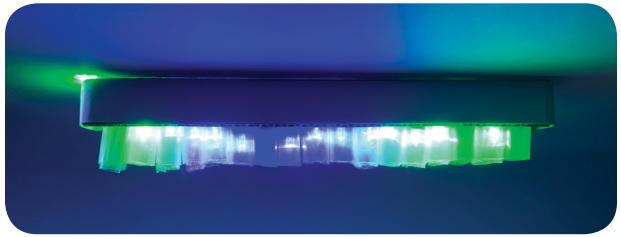
3

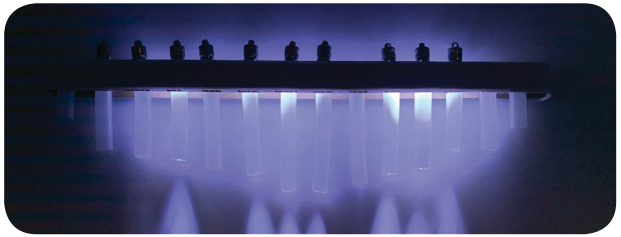
I decided to go with this subtly curved form



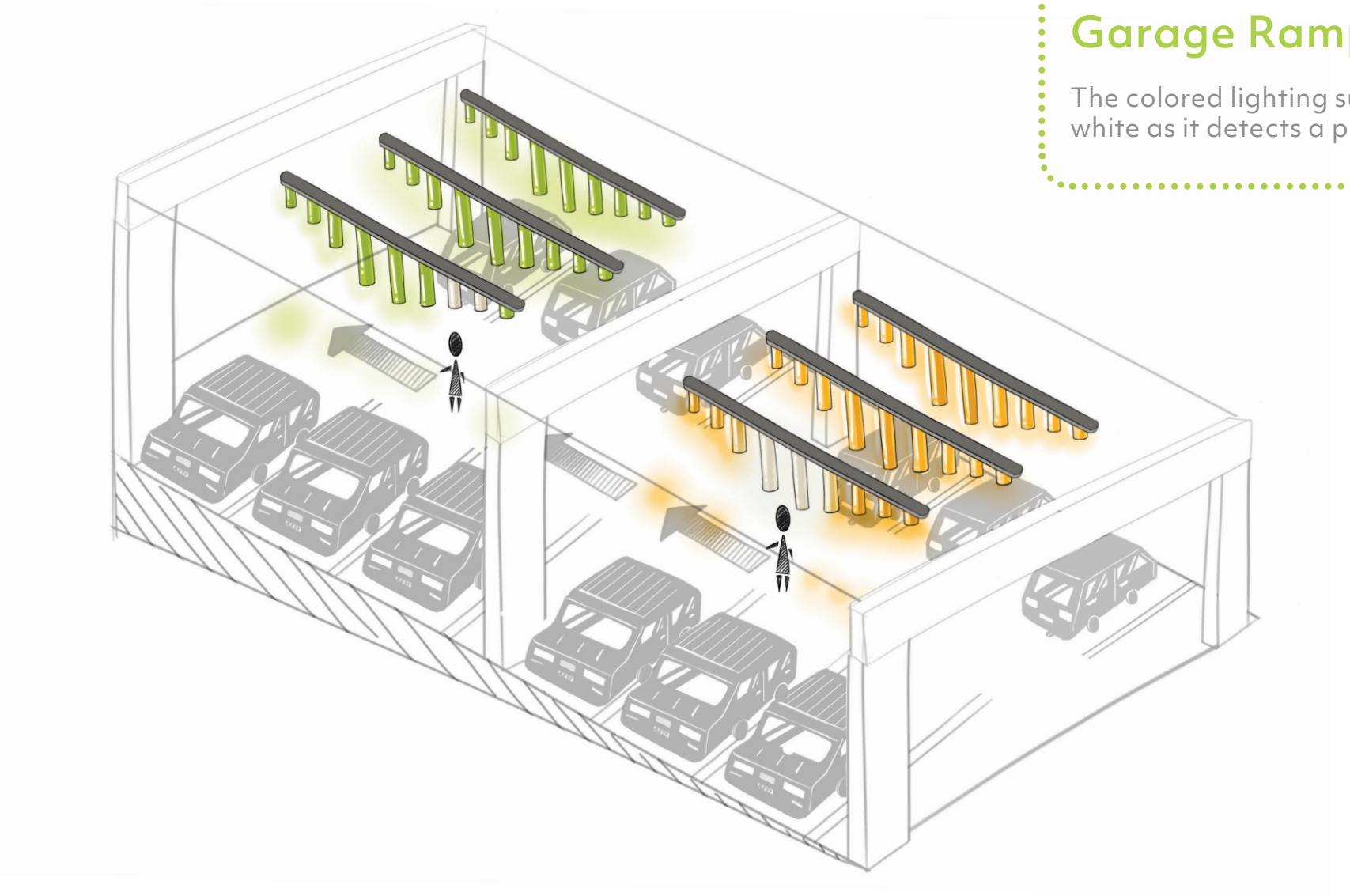
Exploration with Colored LEDs







Final Concept: Sketch



Garage Ramp

The colored lighting subtly gradates to white as it detects a person walking by.

Appearance Model: Materials Needed

1.

1/4 in wood board as fixture's base

2.

Transparent plastic tube as light shade

3.

LED light with remote control

4.

Gray Spray Paint

5.

Glue

6.

Mask and sanding paper

Appearance Model: Making Process

1.

Laser cut all pieces on 1/4" woodboard

2.

Glue the pieces together and let dry

3.

Glue the LED lights to the wooden base

4.

Glue the cover piece on and let dry

5.

Put wood filler all around the wooden base to erease gaps

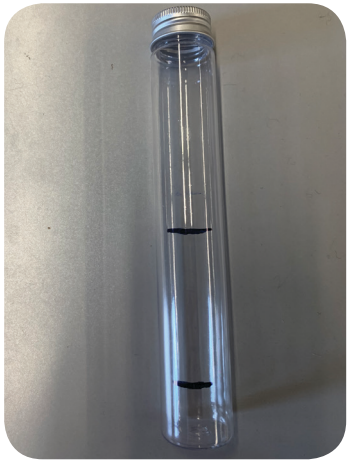
6.

Sand once the wood fillers are set

7.

Spray paint

8.



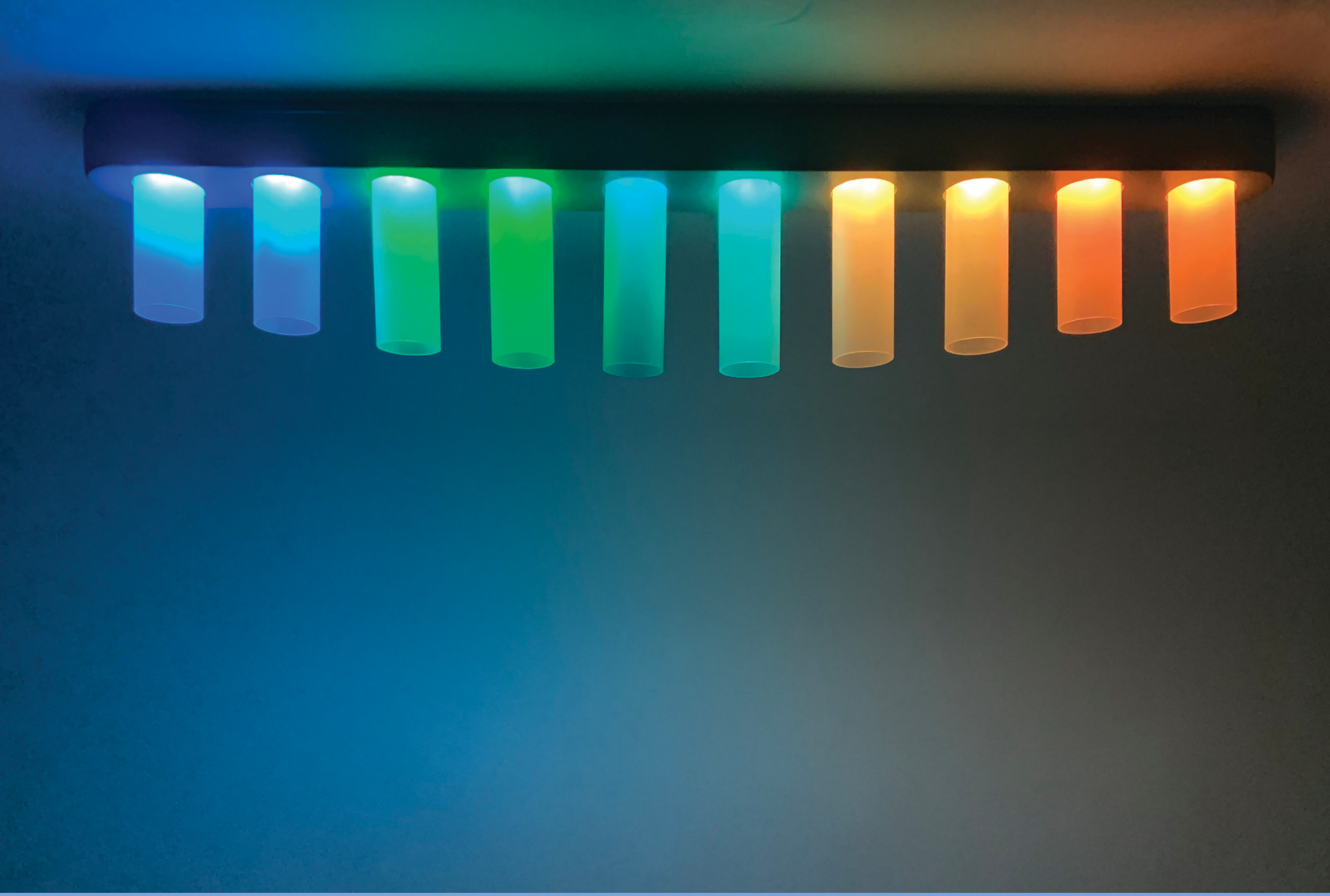
Cut plastic test tubes to needed length

9.

Sand blast the pre-cut plastic tube until it's opaque

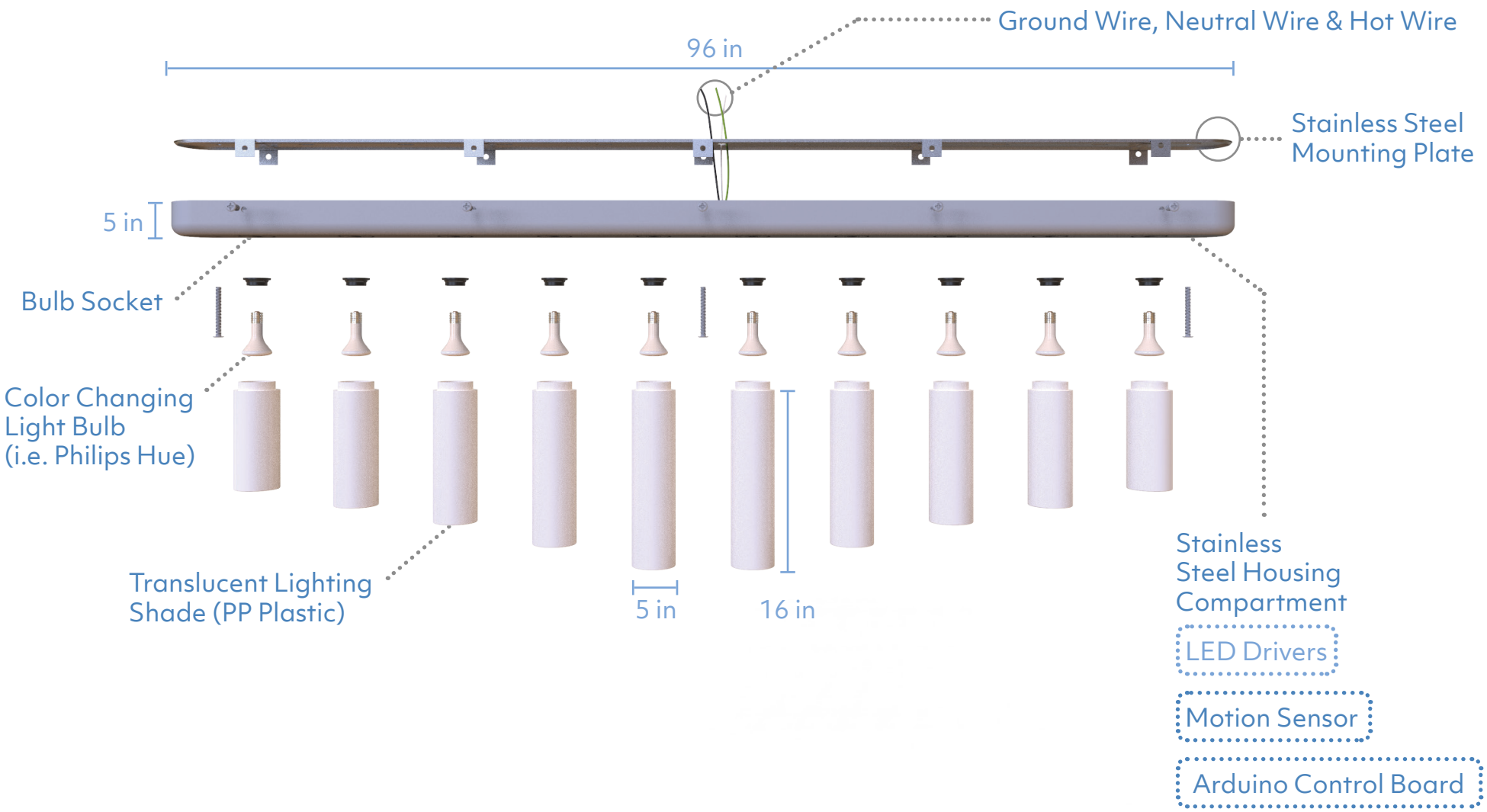
10.

Glue the opaque tubes to the spray-painted base



Appearance Model: Final Product

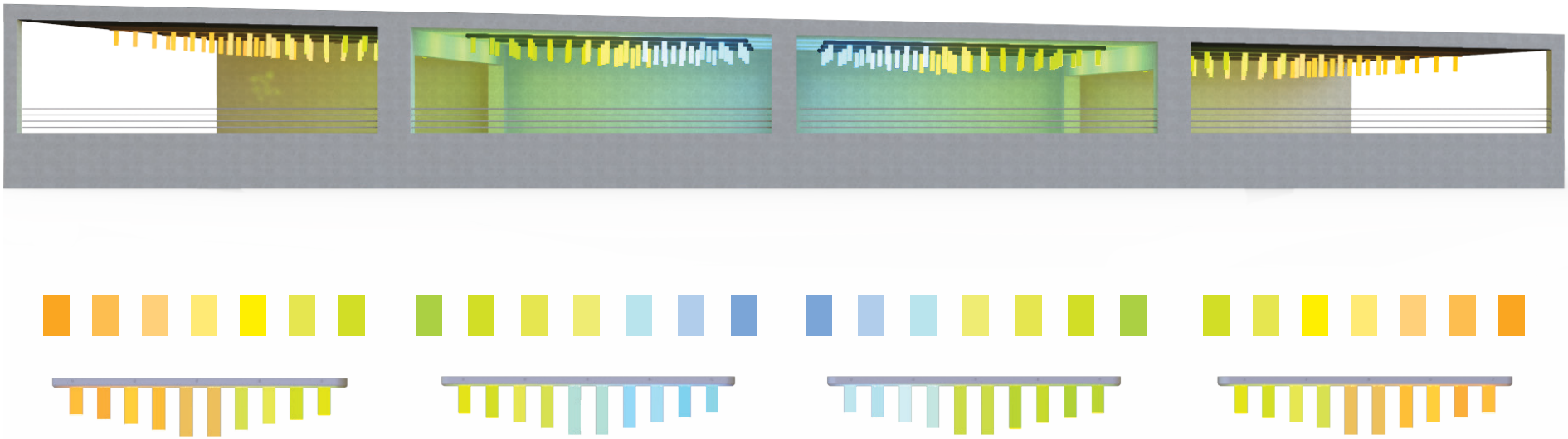
Final Render: Product Specification



Final Render: Design Feature 1

Garage Side View of 1st Floor Ramp

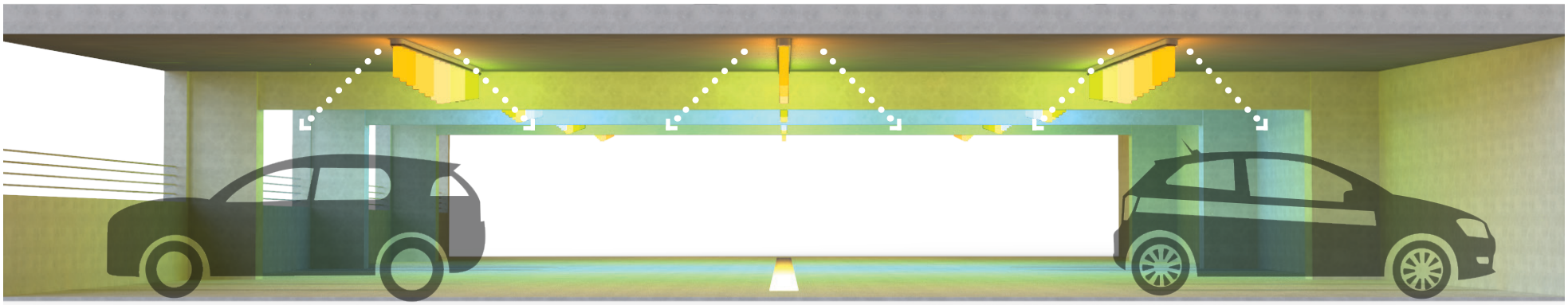
- Chromatic lighting disrupts the monolithic garage interior.
- Colored lighting subtly gradates to white light as it detects pedestrian passage.



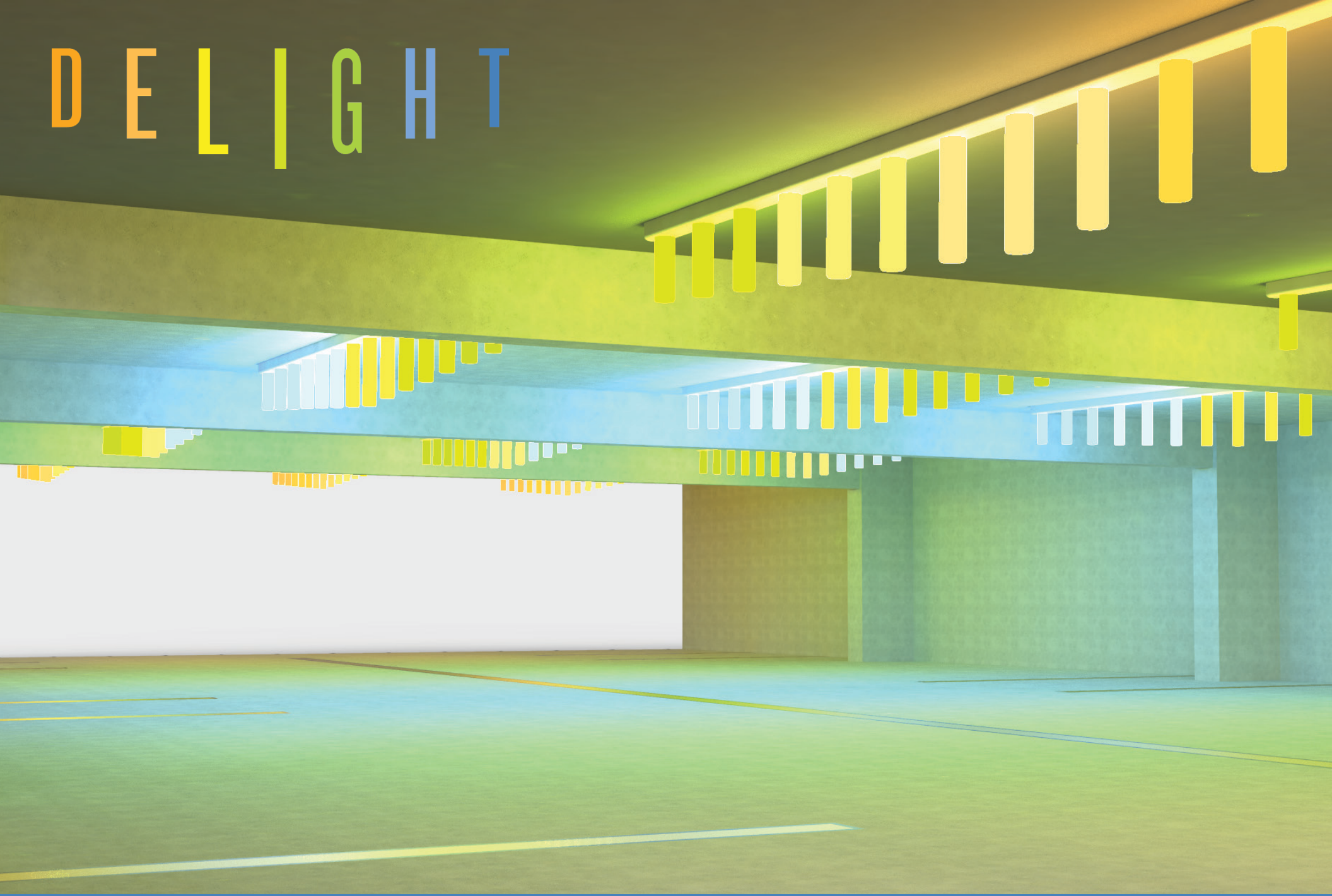
Final Render: Design Feature 2

Garage Front View of 1st Floor Ramp

- Three fixtures installed across garage to evenly distribute light, eliminating shadow areas.
- Fixtures auto dim and glow during night, creating movement within the garage in hope to keep away crimes.



DELIGHT



DELIGHT is a Smart Lighting System designed to disrupt the negative garage environment in Union South, allowing for color, movement and sense of safety.

OSU Industrial Design Senior Thesis Process Book